An Improved Microwave Satellite Data Suite for Hydrological and Climatological Applications

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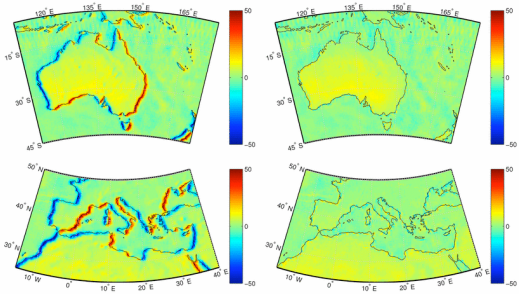
http://cics.umd.edu/AMSU-CDR/home.html

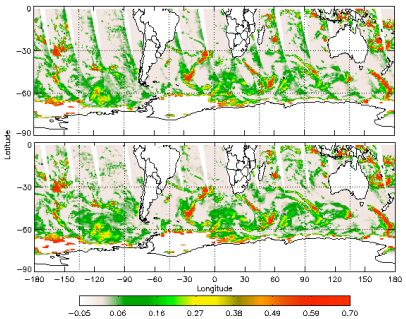
Introduction

Based on more than one decade of observations from the Advanced Microwave Sounding Unit (AMSU) onboard the polar-orbiting satellites NOAA-15 to -19, and EU Meteorological Operational satellite program-A (MetOp-A), a suite of global hydrological products (12 products), including rain rate and snowfall detection, total precipitable water, cloud liquid water, and etc., has been developed. After the correction of the geolocation, radiometric and spectral errors of the AMSU-A window channels, and AMSU-B/MHS water vapor channels, the quality of the data suite has been improved through the generation of Fundamental Climate Data Records (FCDR) which also include inter-satellite calibrations. Using the FCDR as input into a legacy operational product system, Thematic CDR (TCDR) are also generated and can be used to support both meteorological to climatological applications.

Geolocation Correction: before (left) and after (right)



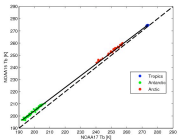
CLW before (upper) and after (lower) Scan Bias Correction



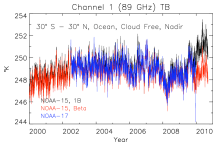
Inter-Calibration: SNO for AMSU-A Window Channels

1. Generate intermediate simultaneous nadir overpass (SNO) data set with 142 variables for each SNO events
2. Calculate SNO coefficients (α, β, a_0, a_1)
3. Set $\delta R_{N15} = 0$ and μ_{N15}, calculate δR_k, μ_k, k = 1 to 5
4. Generate level-1c radiances for all six satellites using recalibration coefficients
5. Compute tropical ocean mean time series of ΔTb for available overlaps between pairs
6. Change the value of μ_{N15} and repeat steps 3, 4, and 5
7. Stop when summation of root mean square of ΔTb is minimum

Inter-Calibration for Water Vapor Channels

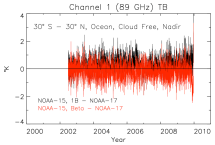


(a) Obtaining coefficients



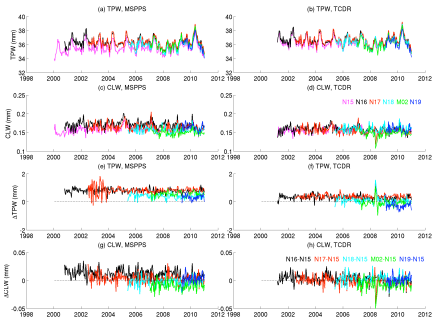
(c) Brightness temperature time series

(b) Coefficients time series



(d) BT difference time series

Impact of Inter-Calibration on Product Time Series

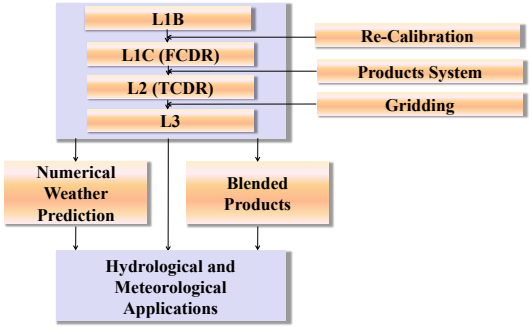


AMSU Hydrological Products – TCDR's

Products	Main Channels (GHz) Used in MSPPS*
Rain Rate	23.8, 31.4, 50.3, 89, 150/157, 183.3±1, ±3, ±7/190.3
Ice Water Path	23.8, 31.4, 89, 150/157
Total Precipitable Water	23.8, 31.4
Cloud Liquid Water	23.8, 31.4
Snow Cover	23.8, 31.4, 89
Snow Water Equivalent	23.8, 31.4, 89
Sea Ice	23.8, 31.4, 50.3

* Short for Microwave Surface and Precipitation Products System. In Microwave Integrated Retrieval System (MIRS), all AMSU AMSU-A, -B/ Microwave Humidity Sounder (MHS) channels are used in product retrievals

AMSU/MHS Production Chain



Impact of Adding Satellites to Daily Averages

- Averages for one day, using NOAA 15, 16, 18, 19, and MetOP-A estimates
- Spatial correlation with GPCP used to rank satellites; average best 1, 3, and all
- More satellites help sample daily cycle; observations need to be more evenly spread over the day for further improvements